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ABSTRACT

This paper discusses two conflicting opinions on the role of computer education within the West German school curriculum, i.e., the opinion of the majority of the education ministers and administrators, who wish to see computer use distributed over as many school subjects as possible, and a minority of specialists in computer education who prefer an integration model, which would provide a block of integrated instruction in grade 8, followed by computer use in various subjects over the next 2 years. The two models--distribution and integration--are briefly described, and the rationale for each of them is given: political authorities who favor the distribution model are aiming at rapid and widespread application of computers in schools in order to complement computer applications in trade and industry, while the proponents of the integration model seek to provide computer literacy for everyone. The curriculum as envisaged by the integration model is then discussed and a diagram is provided which illustrates the relationships of the four thematically linked fields that comprise the model: applications and effects of information processing, problem solving with algorithmic methods, principles of software and hardware systems, and applications of the user system. A comparison of the two models which points out the advantages and disadvantages of each concludes the paper. The two models are further illustrated in the appendices by charts showing the computer curriculum in Baden/Wurttemberg (the distribution model) and Zurich (the integration model). A 17-item reference list is also provided. (DJR)

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Karl Frey: Computer Education in Schools: The Distribution Model and the Integration Model in the Federal Republic of Germany*

Paper presented at the annual meeting of the American Educational Research Association, San Francisco, April 16 - 20, 1986

Symposium:
Computers in Education. Issues for Curriculum from European and North American Perspectives
(Decker Walker (Chairman), John Hartley, Peter Pereira, John Olson, Karl Frey)

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Karl Frey:
Computer Education in Schools:
The Distribution Model and the Integration Model
in the Federal Republic of Germany

Summary:

The two conflicting opinions on the role of computer education with the curriculum are the topic of this paper. In ths distribution model, computer education is "distributed" throughout a range of subjects. The integration model gives a basic introductory course in computer literacy in a block of about six weeks. The motives behind the two models and the curriculum as envisaged by the proponents of the integration model are also discussed. The last section is a comparison of the two models.

IR 013 555

1. The two models

In the Federal Republic of Germany there are two conflicting opinions on the role of computer education within the curriculum as a whole. The majority of education ministers and administrators would like to see computer use distributed over as many school subjects as possible. Their aim is for computers to be used, for example, during 20 periods of mathematics, 10 periods of geography, 12 periods of chemistry and so on to include a wide range of subjects. The computer should be used wherever feasible, which means in around 10 subjects. At this point it should be mentioned that in the Federal Republic of Germany, as in most European countries, quite a different subject timetable is followed from that common in North America, where a student normally has the same subject every day for three months or a semester. In Germany, on the other hand, the students generally have only one, two or three periods in each subject per week and stay with the same subjects over a period of several years, perhaps even for the whole of their school career. If computers are to be used in several different subjects, this means in practice that 12 chemistry lessons would be spread over four to six weeks. The computer is then only used for a short spell, though in a variety of subjects (cf. Appendix 1).

This distribution model for the computer in compulsory education has been opposed by a minority who have produced instead an integration model and developed it into a curricular concept. On the basis of this model, students would not receive their introductory instruction with computers in five to ten different subjects, but in a block of 60 to 120 periods. This basic instruction is aimed at grade eight, and it is followed by computer use in the individual subjects. Protagonists of the integration model include a number of specialists in computer education, the educational administration of the Land (state) of North Rhine Westphalia and computer educationalists at the IPN. Further support for the integrated model comes from the canton of Zurich in

Switzerland and the national curriculum institute of the Netherlands (SLO).

In March 1984, at a national conference in the Federal Republic of Germany, the position of the integration model in the curriculum as a whole was discussed and its implementation recognized as a medium-term goal. The model provides for an integrated instruction block in grade eight (13 - 16 year-old students), followed by computer use in various subjects over the next two years (grades nine and ten). Parallel to the latter, an optional subject would encompass two to four periods per week. Those students attending the academic track of the tripartite school system, Gymnasium, and aiming at the Gymnasium final examination at the end of grade 13 (equivalent to the qualification obtained at the end of Junior College in the USA) would take a second integrated block in grade 11. The following chart, published in a report by PESCHKE, HULLEN and DIEMER (1984), provides a schematic view of instruction as envisaged by the model.

		age
computer literacy for all pupils (foundation I)		13
options	individual subjects	14 15
foundation II		16
subject informatics	individual subjects	17 18

The difference in the curriculum proposed in each model is striking. It becomes even more apparent if the motives behind each model are analyzed, which is the theme of the next section.

2. The motives behind the distribution model

The distribution model is the model of educational policy-makers, i.e. of education ministers, and of administrators. Political authorities are currently aiming at rapid and widespread application of computers in schools in order to complement computer application in trade and industry. The Land of Baden-Württemberg has been quickest and most radical in following this motive. Piecemeal, yet consistently wherever it has been possible, the Ministry of Education has added computer periods to the state guidelines. The Land in which Mercedes are produced hardly considered itself a "nation at risk", yet in the same manner as many of the American commissions it had in mind the support of future economic prosperity. Information processing and computer facilities are thus to be dispersed throughout the education system in the same way as they are dispersed throughout trade and industry.

The second motive is more defensive in nature, a consequence of the well-established differentiation of the education system. Most ministerial staff, and thus the ministers themselves, adapt to the given structures. They were wary of introducing a new subject: other subjects would have had to surrender periods in favour of the newcomer, as the compulsory number of periods per week was already fixed. Teachers' associations, particularly subject teachers' associations, are so influential in the Federal Republic that a public debate on the subjects to be reduced could have delayed the introduction of computers in schools for several years.

3. The motives behind the integration model

The fundamental motive behind the integration model is obvious: the first encounter with the world of computers at school should not merely involve using the machines. The students should instead encounter all important aspects of the computer. They should have the opportunity of gaining practical knowledge and experience of the computer's history,

of its construction, its effects on society and its ability to help young people answer questions, as well as on its drawbacks. The students should not experience computers in an exclusively functional capacity, but should deal with them in a variety of ways in order to be able to approach them as educated people later on. This motive corresponds to a classic European conception of education. Young people should encounter the phenomenon from all angles, analyze it as far as possible and be able to manipulate it.

There have been, however, two cases of rather negative experience with applied education programs in German schools which add weight to the arguments in favour of the integration model. Five to ten years ago, an attempt was made to apply interdisciplinary principles to health and environmental education. Since then, research in schools has shown that both health and environmental education have to a great extent remained piecemeal enterprises (on health education cf. JÜDES et al., 1985; on environmental education cf. EULEFELD, 1978). Health and environmental education are in evidence, yet it is left to the students to integrate the separate pieces of knowledge they acquire. With computers there is a great danger that only a few applications or elementary programming skills would be communicated, which can in no way be described as a comprehensive education. There is, therefore, ample indication that interdisciplinary themes are best dealt with at one time, i.e. in one block (cf. HAMEYER, 1983).

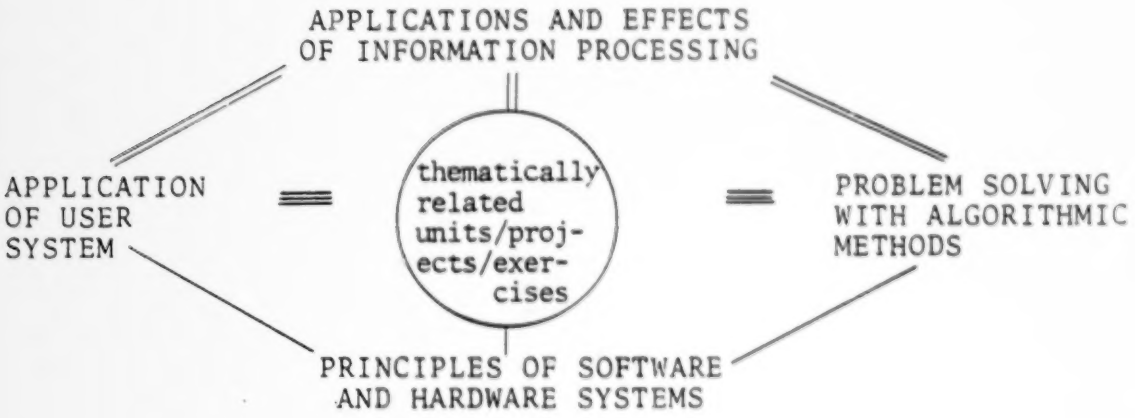
4. The curriculum as envisaged by the integration model

The integration model sets out to provide basic computer literacy for everyone. The process by which the curriculum for the model was produced also follows this principle. We used the curriculum conference approach. Twelve guests were invited to a one-week curriculum conference. In line with the concept of the curriculum conference they were neutral, qualified in the field of education, informed about the area in question - though not specialists. A few weeks before

the curriculum conference was due to begin these future curriculum developers received a copy of the "conspectus", a review of current knowledge on the topic at hand, commencing with the history of the field, followed by an account of the present situation and future perspectives. The conspectus is practically a "state of the art" paper, written in the case of this particular curriculum conference by two experts and checked by half a dozen more in order to produce as complete and balanced a picture as possible of the computer in modern industrial society (VAN WEERT, HAMPE, 1984 a/b). The conspectus is designed to provide the invited curriculum developers (who are not, it must be remembered, specialists in areas such as hardware or computer languages) with information from which they can gain an understanding of the field, or which they can at least consult if questions arise. In keeping with the curriculum conference concept, the experts who compiled the conspectus were also present during the week of the conference itself. In order to avoid a mere reproduction of technologies and other bodies of knowledge the experts only provide information on request and ensure that all curriculum proposals are scientifically sound. As the nature of the curriculum-making process is reflected in the subsequent curriculum (cf. e.g. Searles, 1981), the work during the week follows the principles of pedagogical interaction. The process of deliberation takes into consideration the rules of rational argumentation and the open emotional interaction between those present. These elements are expressly introduced into the work and agreed upon individually by the participants (cf. FREY, 1981; 1983; for theoretical foundation also KÜNZLI, 1975; HAMEYER, 1985).

The curriculum conference on computers in education,, which took place in spring 1985, produced the curriculum described below. It sets out to answer the following question:
What form should introductory general instruction on and with the computer take if 40 - 120 periods are available and the instruction is for adults or 13 to 15 year-old students?

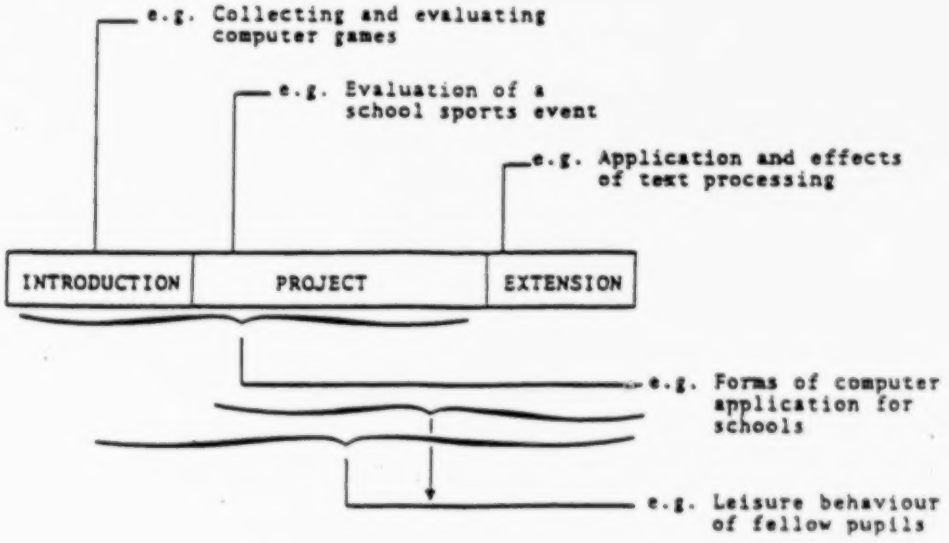
The curriculum consists of four thematically linked fields, each of individual significance. Equal emphasis is placed on each field, although they are not treated separately but integrated in project work wherever possible. The following diagram illustrates how the four areas are incorporated.


APPLICATIONS AND EFFECTS OF INFORMATION PROCESSING
APPLICATION OF USER SYSTEM
thematically related units/projects/exercises
PROBLEM SOLVING WITH ALGORITHMIC METHODS
PRINCIPLES OF SOFTWARE AND HARDWARE SYSTEMS

Approximately one half of the curriculum is devoted to project-type work. The students take, for example, their leisure activities as a theme. They compile lists, classify the activities, write the necessary program and feed the data into the computer. In doing so, the students familiarize themselves with various elements of hardware and software, although the teacher gives only a brief explanation of the latter where necessary. After a time the students see their own behaviour and that of their friends stored and systematized. In schools this exercise often leads to discussions on the purpose of data collection, on privacy and data protection, because not all students are usually willing to surrender information on their activities - they might like their classmates to know, but not the teacher.

The project section of the curriculum is complemented by two further sections, comprising an introduction of approximately 10 periods and a section of further information for the rest of the periods available. In these two informative sections those fields of the four are dealt with which were not major

features of the project, e.g. word processing or algorithm formation. The following diagram shows the structure of the curriculum. During the curriculum conference a total of eight proposals for alternative projects and accompanying extension sections were discussed (cf. German edition of BOSLER, HAMPE, WANKE, VAN WEERT, 1985).


e.g. Collecting and evaluating computer games
e.g. Evaluation of a school sports event
e.g. Application and effects of text processing
INTRODUCTION
PROJECT
EXTENSION
e.g. Forms of computer application for schools
e.g. Leisure behaviour of fellow pupils

In an example from Switzerland (cf. Appendix 2) the integration model was reduced to a single week (DIETIKER, 1985), though the structure was retained. Tested in Zurich, this example of integrated instruction clearly demonstrates how the four themes are intertwined and thus form a valuable medium of education.

5. Comparison of the distribution and integration models

No quantitative evaluation results are available to date. I can thus only comment on the basis of interim reports and experiences.

In Baden-Württemberg, where the distribution model has been implemented with great support from the state authorities and those sections of the press in favour of economic growth, a quite unexpected phenomenon has occurred. Teachers who had for years been in a state of apathy and who had rarely taken part in in-service training activities were

enthusiastic about the new element in instruction. And it is interesting to note here that the in-service training in computers, which the Minister of Education made compulsory, was conducive to this enthusiasm. Something happened which OLSON (1986) missed in his Candaian case studies. Suddenly the teachers found that they had a modern profession. The introduction of computers had a revitalizing effect, although the extent to which this has been transmitted to students has not yet been ascertained.

The aim of the distribution model is to use computers in as many subjects as possible, but the focus has been mainly on mathematics and the sciences. Moreover, in these subjects computer literacy can be observed to yield to computational literacy, a process criticized by PEREIRA (1986) in American programs. Students are required to input sets of data in simulation programs, or to carry out other functions similar to those used for programmable pocket calculators.

The distribution model also presents a further problem. With the exception of computer lessons in mathematics, where a certain amount of algorithm building is practiced, the computer is in general merely "used", usually to carry out prescribed tasks. The students thus experience the computer in a functionalized capacity and it is unlikely that enough time is available to explore further possibilities. In fact, it is more probable that much of the computer's "educational potential", a term used by WALKER (1983) will be lost, i.e. will have no effect. HARTLEY's (1986) conception of the computer as a "workstation" appears here far more productive and effective. Within the distribution model there is some scope for discussing, for example, the effects of computers on work and the private sphere. The subjects "vocational studies" or "social studies" offer opportunity for such topics, yet the fact remains that the activity is bound to an individual subject and does not include contact with computer equipment.

The integration model offers far greater scope in this respect. Instruction based on the model has shown so far that all the facets of the computer can be brought out (cf. CARSTENSEN, 1986; DIETIKER, 1985). The students participate actively, work with situations familiar to them personally, such as a local sport event or the editing of a school newspaper.

The integration model has, however, one considerable disadvantage. It does not lend itself readily to use within the existing organizational structures of school. As 10 to 15 parallel subjects are taught every week in the Federal Republic, it is very difficult to find time for a lengthy instruction block. When developing the integration model we envisaged 120 periods. This would mean four to five weeks, approximately the time required by Stanford Institute for Microcomputers for its introduction. But as the Zurich example shows, the integrated section can be reduced to one or two weeks, i.e. 20 to 40 periods. The extent to which such one to two-week projects can provide a reasonable introduction to comprehensive computer education remains to be seen. We hope to be able to submit evaluation results in this area in two to three years' time.

A P P E N D I X 1

Baden/Württemberg

IDK 14.1.86

type of school / subject	Hauptschule	Realschule	Gymnasium
Mathematics	grade 9 Applied Mathematics - Computer application	grade 9; 20 h Applied Mathematics and Computers - Complex problems - Basic methods of problem solving	grade 9; 15 h Principals of Computer Science - Problem analysis - Design and description of an algorithm - Design and test of program - Installation, application and documentation
Social Sciences	grade 9 (optional) Using the computer	grade 9 Professional orientation and present/future labour situation (including importance and consequences of microelectronics)	grade 12 (optional); 75 h Structural chance and economic growth - Development of new technologies - Computer use in information processing - Automation
Technology	grade 9; 12 h Electronics - Application of circuits - Assembly of a computer controlled device - Design of control program - Technical advantages/ - disadvantages	grade 10 (optional); 20 h Basic course on information processing, or Assembly of a computer controlled device, design of control program	
Physics		grade 9 or 10 Computers for simulation studies	grade 11 Programming of simple physical problems, e.g. mechanics by means of a non-complex algorithm
Computer Science			grade 12 or 13 (optional); 60 h - Algorithms - Variable types and fields - Procedures and functions - Structure, peripherals and operating of a computer - Machine-oriented and problem-oriented langua - Historical perspective and social aspects - Applied computer science

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APPENDIX 2

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Model	Introduction to EVA Principle Computer 1	Guided Tour of MACPAINT	Writing and Laying Out Articles	Designing Advertising with MACPAINT	Algorithms for Word Processing 4	Pupils' Experiences in Using the Computer (Report)
Usage	Guided Tour of MACINTOSH and MACWRITE	MACPAINT Exercises	ditto	ditto	Writing and Laying Out Articles	Demonstration of Working at the Computer for Parents and Visitors
Algorithmic Methods	MACWRITE Exercises	Principle Computer Set-up 2	Hardware 3: Memory Bank Peripheral Equipment	Writing and Laying Out Articles	ditto	
Principles of Hardware and Software	Writing and Laying Out Articles	Writing and Laying Out Articles	Algorithms for Word Processing 2	Evaluation of Visit to Zürichbieter	Demonstration of Various Software	Dismantling and Packing the Hardware
Effect on Society						
Preparation (2 Lessons)	MACWRITE Exercises	Visit to Editors' Office at the Zürichbieter in Basserdorf		Algorithms for Word Processing 3	Writing and Laying Out Articles	
Week's Program	Algorithms for Word Processing 1			Editorial Meeting Layout Headlines	Putting Together and Printing the Newspaper	
Contents and Topics of the Newspaper	Preparing to Visit a Newspaper Editors' Office			Writing and Laying Out Articles	ditto	
Distribution of Competence						

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